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ABSTRACT

This booklet, one in a series on aviation careers, outlines the variety of careers available in the aircraft manufacturing industry. The first part of the booklet provides general information about careers in the aerospace industry (of which aircraft manufacturing is one part), including the numbers of various types of workers employed in those careers in 1978 and the estimated numbers employed as of December 1979. The job categories under which the many types of workers are classified are also listed. In the second part, the following five job types of workers are classified are also listed. In the second part, the following five job categories are outlined: scientists and engineers, technicians, production workers, and other administrative and support personnel. For each of these job classifications, information on the nature of the work, working conditions, where the jobs are, wages and benefits, opportunities for advancement, requirements to enter the job, opportunities for training, and outlook for the future is provided. (KC)

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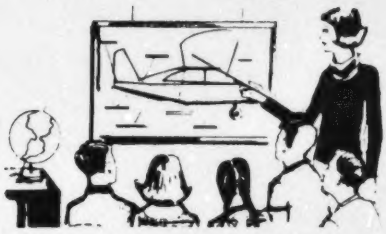

AVIATION EDUCATION

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Aviation Careers Series

AIRCRAFT MANUFACTURING OCCUPATIONS

by
Walter Zaharevitz

U.S. DEPARTMENT OF EDUCATION
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GENERAL INFORMATION

The aerospace industry (of which aircraft manufacturing is one portion) is primarily engaged in the design, development and manufacture of aircraft, missiles, spacecraft, their propulsion, navigation and guidance systems, and other aeronautical and astronautical systems and their components. In 1978, sales by the aerospace industry totaled $37 billion, employment increased to 1,032,000 and the payroll amounted to $19.2 billion. Occupational group employment in the industry was:

	December 1978	December 1979*
Scientists & Engineers	170,000	179,000
Technicians	64,000	70,000
Production Workers	519,000	557,000
"All Others"	279,000	297,000
TOTALS	1,032,000	1,103,000

(*Estimated)

Now that an overall picture of the aerospace industry has been presented, this pamphlet will concentrate on the aviation portion of the industry -- the aircraft manufacturing occupations. The major manufacturing divisions are airframe, components, accessory and equipment, and engine. Workers are grouped as follows: scientists and engineers, technicians, production workers, and "all others" (Administrative and support activities personnel).

Scientists and engineers include all persons engaged in scientific or engineering work which requires a knowledge of training equivalent at least to that acquired through completion of a four-year college course with a major in these areas. Scientific fields include aerodynamics, avionics, ceramics, chemistry, cryogenics, mathematics, meteorology, metallurgy, physics, physiology and psychology. Engineering fields include aerodynamics, avionics, design, engineering reliability, equipment, field service, flight test, instrumentation, manufacturing materials and weights and balance. College degree fields in engineering include aeronautical, aerospace, ceramic, chemical, civil, electronic, electrical, engineering mechanics, engineering physics, industrial, mechanical, metallurgical, and nuclear. One study showed that one out of five of the engineers in the aerospace industry has an aeronautical or aerospace engineering degree -- the others come from other disciplines.

More than half of the industry's scientists and engineers are in research and development work. (The aerospace industry is one of the nation's primary employers of scientists and engineers for research and development.) The remainder are in production planning, quality control, tool designing, technical purchasing, technical sales and service, technical writing and

illustrating, and related fields. Typical technical areas of endeavor include: aircraft and flight equipment, chemical warfare equipment and materials, chemistry, communications, detection, electrical equipment, electronics and electronic equipment, fluid mechanics, fuels and combustion, ground transportation, equipment, installations and construction, materials (non-metallic), mathematics, metallurgy, military sciences and operations, navigation, nuclear propulsion, ordnance, personnel and training, physics, propulsion systems, and research and research equipment.

Technicians include all persons engaged in work requiring knowledge of physical, life, engineering, and mathematical sciences comparable to knowledge acquired through technical institutes, junior college, or other formal post-high school training, or through equivalent on-the-job training or experience. (Craft-workers, such as machinists and electricians, are not included in this definition.) Science technicians and engineering technician fields include all those mentioned above for scientists and engineers, plus drafters and technical writers and illustrators. Examples of technician position titles are: Senior Documentation Analyst, Software Programmer, Contracts Administrator, Technical Illustrator, Technical Writer, Supervisor of Blueprint and Microfilm Files, Tool Designer, Training Equipment Designer, Drafter, Research Mechanic, Research Electrician, Laboratory Technician, Electronics Technician, and Production Planner.

Production workers include working supervisors and all nonsupervisory workers engaged in fabricating, processing, assembling, inspection, receiving, storage, handling, packing, warehousing, shipping, maintenance, repair, janitorial and guard services, product development, auxiliary production for a plant's own use, and recordkeeping and other services closely associated with the above operations. The chief categories of plant occupations are sheet metal work, "other" metal work, machinery and tool fabrication, assembly and installation, inspecting and testing (quality control), flight check-out, materials handling, maintenance, and protective custodial. Typical jobs include the following:

Sheet Metal Occupations

Sheet Metal Workers
Power Brake Operators
Power Hammer Operators
Power Shear Operators
Punch Press Operators
Profile Cutting Machine Operators

Other Metal Processing Occupations

Tube Benders
Riveters
Welders

Foundry Workers: Patternmakers, Molders & Coremakers
Forging Department: Drop Hammer Operators and Others
Heat Treaters
Painters
Platers

Machining and Tool Fabrication Occupations

Milling Machine Operators
Production Machinists
Tooling Machinists
Machine Tool Operators
Jig and Fixture Builders
Tool and Die Makers
Engine Lathe Operators
Tooling Welders
Boring Machine Operators
Precision Honers

Assembly and Installation Occupations

Final Assemblers
Armament Assemblers
Power Plant Installers
Electronics Assemblers
Electrical Assemblers
Plumbing Assemblers
Hydraulic Assemblers
Heating and Ventilating Assemblers
Rigging and Controls Assemblers
Upholsterers

Inspecting and Testing Occupations (Quality Control)

Outside Production Inspector
Receiving Inspectors
Machined Parts Inspectors
Fabrication Inspectors
Assembly Inspectors
Tool Inspectors
Template Inspectors
Gauge Inspectors
Electrical Inspectors
Flight Line Inspectors

Flight Check-Out Occupations

Chief Mechanics or Crew Chiefs
Engine Mechanics
Electronics Mechanics

Materials Handling Occupations

Truck Drivers
Crane Operators
Shipping Clerks
Tool Crib Attendants

Maintenance Occupations

Maintenance Mechanics
Millwrights
Electricians
Carpenters
Plumbers
Painters
Welders

Protective and Custodial Occupations

Guards
Firefighters
Janitors

The "All Others" category includes all administrative and support activities personnel. These positions include executives responsible for direction and supervision of research and production; officials in departments such as sales, purchasing, personnel, accounting, public relations, advertising, and industrial relations; and secretaries, stenographers, typists, clerks, and tabulating machine operators.

NATURE OF THE WORK

Scientists, Engineers and Technicians: Almost every branch of science and engineering is involved in the solutions of the great variety of problems associated with the design and production of faster and more efficient aircraft and the in-flight operation and ground servicing of planes, their passengers and cargo. Increasingly more complex mechanical and electrical equipment is necessary for our airlines. The challenge includes the search for aircraft with short takeoff and landing (V/STOL) capabilities and for the design of aircraft for specialized work use and for recreation purposes. All designs must stress improved safety factors.

These professional and semi-professional workers may be assigned to concentrate on tasks involving one of three major areas: (1) research, design or development; (2) production, operation or control; and (3) installation, maintenance or sales engineering.

The emphasis is on thinking and on team work -- a coordinated effort of scientists, engineers and technicians. The scientists are chiefly concerned with basic and applied research: the search for scientific knowledge, new concepts, the extension of theory, and the practical applications of this knowledge and theory. The engineer normally has a definite goal in mind: the engineer's design for a specific piece of equipment to do a specific task. Technicians work closely with the scientists and engineers and concentrate more on the practical aspects of using and testing equipment than on the theory involved in building it. Technicians usually begin as trainees or in the more routine positions under the direct supervision of an experienced technician, scientist or engineer. More responsible assignments are undertaken as technicians gain experience. The team is concerned with all phases of the development of their assigned project -- from the initial planning and design to the final manufacture and testing.

Production Workers: A little more than half of all aircraft manufacturing workers are production workers ("blue collar" occupations). These workers fabricate, assemble, install, test and inspect the many parts which make up a modern airplane. Other plant workers handle material and provide maintenance and custodial services. These occupations range from highly skilled to semi-skilled jobs.

WORKING CONDITIONS

Scientists, engineers and technicians work primarily indoors at a desk or in a research department, laboratory or engineering department in a modern, clean and temperature-controlled factory building. Some outdoor work may be necessary. The various departments are normally equipped with the latest electronic and mechanical instruments, laboratory apparatus, and drafting instruments.

Production workers work in departments such as riveting, metal-processing, and welding which are noisy areas of work. Some jobs generate fumes and odors. Some employees, especially assemblers, work in hard-to-reach cramped spaces requiring much stooping, kneeling, crouching, and crawling to perform their tasks. Many operations, such as assembly, welding, molding, mechanic and machine shop jobs require frequent lifting or carrying of heavy (up to 50 pounds) and medium (up to 25 pounds) loads. Although some hazards are associated with the aircraft industry, aviation plants are safe working places -- with an injury-frequency rate averaging less than that for the manufacturing industry as a whole.

Administrative and support activities personnel normally work in modern, clean, and temperature-controlled offices.

WHERE THE JOBS ARE

Aircraft manufacturing jobs exist in almost every state. The largest concentration is in California. Other states with large numbers of jobs include New York, Washington, Connecticut, Texas, Florida, Ohio, Missouri, Pennsylvania, Massachusetts, Kansas, Alabama, Maryland, New Jersey and Georgia. Aerospace employment is highest in the Pacific region, where more than 40 percent of all aerospace employees work. Another 14 percent live and work in New England, while ten percent are in the Middle Atlantic states. The remaining 36 percent are scattered throughout the central and southern United States.

WAGES AND BENEFITS

Salaries for employees in this industry are generally higher than those for similar work in most other industries. Wages vary according to workers' skills and experience and they differ from plant to plant, depending upon the type of plant and the locality. The following fringe benefits are common in this industry and are comparable with those in other industries: two weeks of paid vacation after employment of one to two years, and three weeks, after ten or twelve years; six to eight paid holidays per year; one week of paid sick leave; insurance covering life, medical, surgical, hospital and accident and health; and retirement pensions.

Scientists and Engineers: Depending upon the demand for the speciality and on individual abilities, the entry level salary of a scientist or engineer is $15,000 to $16,000 per year. Scientists and engineers are normally on the day shift. Attendance at seminars and meetings of professional societies is often paid by the company. Some companies also pay the membership dues to professional societies.

Science Technicians and Engineering Technicians: Entry level technicians' salaries are about $10,460 per year with a senior technician receiving about $18,703 per year. The starting salary will depend upon the technician's technical specialty and education and upon experience. Technicians are normally on the day shift.

Production Workers: Shift work (with three in operation) is normally required for production workers. An increase in salary is generally paid workers on the second and third shifts. Production workers average weekly earnings amount to $342.71.

Administrative and Support Activities Personnel: Salaries are generally higher than those for similar work in most other industries. "White Collar" workers are normally on the day shift.

OPPORTUNITIES FOR ADVANCEMENT

Scientists and Engineers: Advancement in salary levels is available; i.e., Senior Scientist or Senior Engineer. However, the chief advancement possibilities involve supervision and management and executive positions. The "team" or "project" concept in attacking various goals has increased the need for management talent and thus the opportunities for scientists and engineers.

Science Technicians and Engineering Technicians: With further education, a technician can advance to a professional position. Technicians are also advanced by being assigned tasks normally performed by professionals and they may move into supervisory positions. Technicians who have a good working knowledge of the equipment produced by the company and who have good personalities may become company sales persons, technical representatives or trouble-shooters.

Production Workers: Traditionally, skilled workers may advance to positions requiring higher skills and experience such as foremen, inspectors and supervisors. Educational opportunities are available to advance to semi-professional positions. A possible advancement program in engineering might be from Assembler to Quality Control (testing) to Engineering Technician to Junior Engineer and finally to Engineer. Union contracts normally require advancement of semi-skilled workers to be based upon seniority of qualified individuals. By participating in courses conducted by the company or by vocational or technical schools in the local community, semi-skilled workers may prepare themselves for a skilled job, such as blueprint reading, welding or mechanic.

Administrative and Support Activities Personnel: Advancement in these areas is normally to similar positions with greater responsibilities and higher salaries.

REQUIREMENTS TO ENTER THE JOB

In general terms, the aircraft manufacturing industry is seeking individuals with self-discipline, a willingness to accept responsibility, a sound foundation in technology, and a team spirit. There are many employment opportunities for women in this industry. In one aircraft plant, women fill 70 different job classifications and comprise 16 percent of the total number of employees. Stanford University recently reported an increase in the number of freshmen women enrolling in engineering because of the especially good job prospects.

Scientists and Engineers: A college degree in one of the sciences or in engineering is the minimum requirement for scientific or engineering jobs. A few individuals with years of semi-professional experience and some college or college-equivalent training may be hired as professionals, but this is now so rare that perhaps it should not even be mentioned. An interdisciplinary approach is being used increasingly and this requires better training in, for example, the interrelated functions of mathematics, physics, and chemistry. A solid foundation in the fundamental concepts and basic general areas of science and engineering is recommended. There is a need for constant study to keep up with the technical fields - a need to constantly readjust to the rapidly changing technology. Professionals with advanced degrees are common in this industry.

Science Technicians and Engineering Technicians: Much of what has been mentioned above for scientists and engineers applies to technicians. An Associate in Science Degree or Associate in Engineering Degree or a diploma from a college or university, junior or community college, technical institute or technical or vocational school is normally required. (Technical institutes offer training designed to qualify the graduate for a specific job or cluster of jobs immediately upon graduation, and with a minimum of on-the-job training.) One may also become qualified for some technician jobs by completing an on-the-job training program, through work experience, and part-time, formal post-secondary school level courses, or through training and experience obtained while on active duty with the military services.

Production Workers: Training requirements for plant jobs vary from a few days of on-the-job instruction for semi-skilled workers, such as material handlers and guards, to several years of formal apprenticeship for craftworkers such as machinists, tool and die makers aircraft mechanics, sheet metal workers, pattern-makers, and electricians. Many levels of skill are required for many plant jobs. Workers with little or no previous training or experience may be hired for the less skilled assembly jobs. Skilled assemblers may need two to four years of plant experience, plus a high school or vocational or technical school education, or the equivalent. Generally speaking, starting workers with little experience serve as helpers or assistants and develop their skills on the job and through plant training courses. An individual may increase chances of being hired by acquiring a skill through vocational or technical school attendance.

Administrative and Support Activities Personnel: The requirements for employment of managerial and administrative personnel are generally comparable with similar jobs in other industries. Employability can be enhanced by acquiring a knowledge of engineering, technology, and the aviation industry because of the nature of the aircraft manufacturing industry as it relates to research and development and production.

OPPORTUNITIES FOR TRAINING

Because workers who are highly trained and are aware of new developments are needed in the industry, the majority of aircraft plants support some kind of formal worker training program. Most of the plants conduct training classes themselves, others pay tuition and related costs for outside courses taken by their employees at vocational or technical or adult education programs offered by the local community, and some plants do both. Some classes are held during working hours, with the trainee being paid for class time. Other classes are held after working hours. Courses are available for practically every occupational group and cover many skills and areas of knowledge.

Many aircraft plants provide their employees with financial aid for college enrollment. This aid is furnished either as direct grants or in the form of scholarships and it is possible for an employee to work and to continue his or her education at the same time. These opportunities help workers advance more rapidly to higher skills and to better paid jobs.

The further one goes in school, the greater are the opportunities for employment. The best jobs go to those with the most education. At least a high school education is practically mandatory for any worker in the aircraft industry. Post-secondary school training is vitally important and such training may be obtained from: area vocational-technical schools, technical institutes, junior or community colleges, or four-year colleges or universities.

OUTLOOK FOR THE FUTURE

Employment in the aerospace industry is expected to rise above recent levels in the next few years. Thousands of jobs will open each year because of the growth expected in the industry, and to replace workers who retire, die or transfer to jobs in other industries. Job opportunities should be most favorable for highly trained workers such as scientists, engineers, and technicians. Less skilled and unskilled workers will also be needed to fill entry level production positions.

Growing demands for civilian aircraft products is an important element underlying the expected increase in aviation employment. The increasing mobility of the population should encourage expanded use of large wide-bodied commercial aircraft and development of rapid air taxi operations between major urban centers. Increased business flying, expanded use of helicopters for such tasks as medical evacuation and traffic reporting, and exports of aircraft to foreign nations are some of the other major factors influencing the growth of civilian aircraft manufacturing.

A portion of the production of the aviation industry is devoted to national defense. Therefore, the industry's future depends on the level of federal expenditures. Changes in these expenditures usually have been accompanied by sharp fluctuations in employment.

Sales in the aerospace industry reached $37 billion in 1978, up about $5 billion over 1977. Among the three major areas of aerospace activity, the largest increment of gain was in commercial sales, but sales to the Department of Defense also increased substantially. NASA sales remained relatively constant. Sales of commercial transports are expected to remain strong at least through the mid-eighties, with an increase in 1979 of more than $4 billion over the current year's level.

Aerospace industry employment in December 1978 climbed to 1,032,000. By the end of 1979, employment is expected to exceed 1,100,000 -- an increase since December 1977 of 23 percent in 24 months. The projected dramatic increase in employment is primarily due to civil aircraft production, especially commercial transport aircraft. In this category alone, the employment level is expected to reach 81,000 by the end of 1979 -- an increase of 80 percent over the low employment levels in 1976 of 44,700.

Military aircraft manufacturing is expected to reverse recent trends and show a modest six percent gain in employment between December 1978 and December 1979.

Helicopter manufacturing employment will increase by 8.6 percent during 1979, continuing the gradual growth pattern of the 1970s.

The category of "other related products" -- avionics, basic research, and non-aerospace products and services -- continues strong and reached an employment level of 263,000 in December 1978, an increase of about 42,000 employees from December 1977. It is expected that by the end of 1979, an additional 22,000 people will be employed for such programs, reaching an estimated 285,000.

AIRCRAFT INDUSTRY EMPLOYMENT - AIRCRAFT AND PARTS*
December 1973 - December 1979

Type Employment	1973	1974	1975	1978	1979*
Scientists & Engineers	70,000	73,000	72,000	71,000	75,000
Technicians	29,000	28,000	26,000	26,000	29,000
Production Workers	335,000	326,000	285,000	330,000	361,000
All Others	121,000	126,000	121,000	128,000	139,000
TOTAL	555,000	553,000	504,000	555,000	604,000

*Source: Aerospace Industries Association

**Forecast

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